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$$AQ_0 = AB \sin \theta = 2AB \sin \frac{1}{2} \theta \cos \frac{1}{2} \theta = 2^2 AB \sin(\theta/2^2) \cos(\theta/2^2) \cos \frac{1}{2} \theta \\ = 2^n AB \sin(\theta/2^n) \cos \frac{1}{2} \theta \cos(\theta/2^2) \dots \cos(\theta/2^{n-1}).$$

$$AQ_n = AB \sin(\theta/2^n).$$

$$\therefore (AQ_0/AQ_n) = 2^n \cos \frac{1}{2} \theta \cos(\theta/2^2) \dots \cos(\theta/2^{n-1}).$$

$$BQ_1 \cdot BQ_2 \cdot BQ_3 \dots BQ_n = (AB^n) \cos \frac{1}{2} \theta \cos(\theta/2^2) \dots \cos(\theta/2^{n-1}) \\ = (\frac{1}{2} AB)^n (AQ_0/AQ_n) = (AO)^n (AQ_0/AQ_n).$$

## CALCULUS.

78. Proposed by COOPER D. SCHMITT, A. M., Professor of Mathematics, University of Tennessee, Knoxville, Tenn.

Investigate value of  $\left(\frac{\tan x}{x}\right)^{1/x^n}$  where  $x$  is 0 and  $n$  has consecutive values 1, 2, 3, 4, ..... Is there any law governing the different results? When  $n=1$ , result is 1; when  $n=2$ , result is  $e^{\frac{1}{2}}$ ;  $n=3$ , gives  $\infty$ , etc.

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.

$$\left(\frac{\tan x}{x}\right)^{1/x^n} = e^{(1/x^n) \log[(\tan x)/x]} = y.$$

$$\text{Limit of } \frac{\log \tan x - \log x}{x^n} = \text{limit of } \frac{\cot x \sec^2 x - (1/x)}{nx^{n-1}} = \text{limit of } \frac{2x - \sin 2x}{nx^n \sin 2x},$$

$$\text{but } \sin 2x = 2x - \frac{8x^3}{6} + \frac{32x^5}{120} - \frac{128x^7}{5040}, \text{ etc.}, = 2x - \frac{4x^3}{3} + \frac{4x^5}{15} - \frac{4x^7}{45} +, \text{ etc.}$$

$$\therefore \frac{2x - \sin 2x}{nx^n \sin 2x} = \frac{2x - 2x + \frac{4x^3}{3} - \frac{4x^5}{15} + \frac{4x^7}{45} -, \text{ etc.}}{nx^{n+1}(2 - \frac{4x^2}{3} + \frac{4x^4}{15} - \frac{4x^6}{45} +, \text{ etc.})} = \frac{30 - 6x^2 + 2x^4}{nx^{n-2}(45 - 30x^2 + 6x^4)}, \text{ ap-}$$

$$\text{proximately, } = \frac{2}{3nx^{n-2}} + \frac{14}{45nx^{n-4}} +, \text{ etc.}, = S.$$

When  $n=1$ ,  $S=0$  for  $x=0$ .

When  $n=2$ ,  $S=\frac{1}{2}$  for  $x=0$ .

When  $n=3, 4, 5$ , etc.,  $S=\infty$  for  $x=0$ .

$\therefore$  When  $n=1$ ,  $y=e^0=1$ .

When  $n=2$ ,  $y=e^{\frac{1}{2}}$ .

When  $n=3, 4, 5$ , etc.,  $y=e^\infty=\infty$ .

Also solved by ELMER SCHUYLER, whose solution has been accidentally misplaced, and hence does not appear in this issue.